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ABSTRACT

A study was conducted at Andrews University, Berrien Springs, Michigan to determine selection of a computer for both academic and administrative purposes. The university has a total enrollment of 2,100 students and includes a college, graduate school and seminary. An initial feasibility study delineated criteria and desirable components of the system as well as an economic analysis and software requirements. Proposal requests were submitted to vendors and a quantitative proposal rating method was designed and applied to each request. The top rated systems were given detailed analysis involving software applications, contracts and conditions, and economic stability analysis of the company and proposed product. Various methods of procurement were also analyzed. Helpful suggestions are given to those planning a selection study and weaknesses of the Andrews study are pointed out. Guidelines for user-vendor relations and contract negotiations are presented. Appendixes contain a list of needs and desires, a cost effectiveness study, criteria and specifications, the weighted rating scheme, a copy of the request for benchmark sent to the vendors, non-standard contractual arrangements and an analysis of different financing methods. (JG)

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METHODS USED IN A RECENT COMPUTER SELECTION STUDY

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IR000 057

ABSTRACT

A study for computer selection at Andrews University, Berrien Springs, Michigan, was completed in February 1973. Methods used in the study are described and critiqued. Recommendations are made based on the experience gained in the study. The computer is to serve as a combined academic and administrative machine for a university with total enrollment of 2100 students. Total system cost is nominally $10,000 per month.

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Section 1

INTRODUCTION

1.1 SCOPE OF STUDY

This report describes a computer selection study conducted at Andrews University, Berrien Springs, Michigan, between August 1972 and February 1973. The study was exhaustive and involved about one man-year of effort. In addition to describing the study, this report incorporates the lessons learned from the study. It is hoped that others ma may benefit from this approach.

Although all careful selection studies have many common elements, there is no single method adequate for all situations. Factors such as institutional size, required user applications, user sophistication, and financial limitations affect the methods used for a study. Some factors affecting the Andrews University study are presented here to set the tone for the description of the study. Andrews University is a private institution with a total enrollment of 2100 students (college, graduate school, and seminary). Size alone dictated a combined academic/administrative computer center. (An investigation was later made to verify this tentative decision). In order to provide for work-study programs,

several commercial enterprises closely associate with the University. Thus the range of computer services required spans most commercial applications. The IBM 360/22 has handled most of these applications well. Unfortunately, the IBM 360/22 has not been adequate for most academic applications (necessitating considerable expenditures for outside services during the past two years). One major purpose for the selection study was to find a system which could handle the existing 500 COBOL programs used in administration while satisfying the bulk of academic requirements. These requirements biased the study in favor of versatility rather than raw throughput and helped establish requirements for main memory user area. The acceptance of a computing system by students and faculty is largely dependent on the ease of use of the system. The selection committee found the most significant single factor in ease of use to be adequate provision for timesharing. Administrative users previously had almost exclusive use of the IBM 360/22. To continue to satisfy those users acceptable concurrent batch and timesharing processing capability is required.

Andrews University offers occupational education courses in keypunch and verifier operation, computer operation, programming and introductory systems analysis. A B.S. in information science will be offered beginning with the Fall 1973-1974 term. Concentrations in information science are also offered as parts of other curriculums. Such offerings obviously require adequate hardware support.

1.2 INITIAL CONSIDERATIONS

There are several preliminary questions which must be met before making a commitment to put forth the effort required to conduct a careful selection study:

- Does a necessity exist for a computer or an upgrade?
- Is there willingness to make a thorough objective study of feasibility, hardware selection, and acquisition?
- Is there bias on the part of computer management, top management, or members of the board to procure nothing but brand "X" equipment? Such entrenched brand loyalty can destroy any benefit which could be gained from an otherwise objective study.

1.3 THE COMMITTEE

It is important to have representatives of the systems analysis/programming, and operations staffs on the selection committee to ensure adequate technical expertise, and acceptance of the findings of the study by the computing center staff. In a university environment faculty members with sophisticated knowledge of computing systems represent a rich resource. Administration representation is also important.

Early financial guidance is very helpful in setting cost criteria. In the final stages of the study (acquisition analysis) and contract negotiations, top management will feel more secure if they are adequately represented. Administration should be in close contact with the study

throughout its progress.

It should be expected when it appears that a sale may be lost, certain vendors will try to high pressure top administrators with sales and scare tactics. Administrators should be aware of such tactics. At Andrews one vendor attempted to convince top administration that the study was not adequate. Being forewarned, they rejected the ploy. Since top management had been kept well informed of the progress of the study, and felt a sense of participation, there was considerable confidence in the study. Since most administrators are laymen in the computing field and have neither sufficient time or interest to become experts, it is important that they have confidence in the technical judgement of those actually conducting the study.

1.4 METHODS USED IN THE SELECTION STUDY

The following methods of study and sources of information were used in the Andrews selection study (or are suggested for use):

- Faculty and administration contacts.
- Vendor contacts.
- Written Request for Proposal.
- Weighted point rating system.
- Datapro 70 and Auerbach Computer Technology Reports.
- Trade journals and publications.
- Reference accounts and other users.
- Consultants.

- Benchmark tests.
- Contract study.
- Corporate stability analysis.
- Detailed procurement analysis.
- Demonstration trip.

Section 2

FEASIBILITY STUDY

2.1 INTRODUCTION

The purpose of this phase of a selection study is to establish required applications, determine acceptable minimums for capabilities and support services, and set system criteria. In a commercial environment, a feasibility study must demonstrate financial returns in excess of cost (unless other factors such as prestige, etc., are highly rated). In the university environment a feasibility study should ensure that the initial procurement meets, but does not greatly exceed, institutional needs. Even in the university environment it is often possible to demonstrate financial returns in excess of cost. (See Appendix C).

It is imperative that this portion of the selection process be completed prior to making vendor contacts. Vendors frequently offer to "do the feasibility study;" however, the user risks a serious bias. The obvious bias would be over-procurement of hardware. Less obvious, but as important, assessment of requirements may be biased to fit the strengths and weaknesses of the specific vendor's products.

2.2 REQUIRED APPLICATIONS

It was the consensus of the selection committee that the proper method for defining hardware requirements was to first define the required applications, then determine software necessary to implement those applications, and only then establish hardware requirements necessary to implement the software. Meetings were held with the individual faculties of most academic departments to obtain directly information on required and desired applications and to project requirements for five years. (A significant byproduct of this interaction, was the stimulation of many faculty members.) The raw data collected in these meetings is attached as Appendix A. The selection committee evaluation of the data is attached as Appendix B.

Similar contacts were made with administrative users and potential users. It rapidly became clear that the academic usage placed the greatest demands on potential system facilities.

2.3 ECONOMIC ANALYSIS

At this point financial guidelines were established. A preliminary study of methods of financing was made to find the lowest cost of money. A reasonable and uniform estimate of procurement costs for proposed systems was based on this preliminary study for purposes of the hardware selection study.

Relevant cost factors were identified so that proper questions could be asked of vendors. Certain factors (eg., power, air conditioning,

bundling policy, etc.) were included with cost factors for this purpose. (See Section 4).

2.4 CRITERIA AND DESIRABLE FEATURES

In establishing minimum requirements it is essential to maintain a careful balance. Criteria should be made known to vendors on the initial contact. This is only fair. Vendors may fail to respond, or respond with little enthusiasm, if criteria are improperly stated. Of course, if the vendor does not have a product which meets institutional needs it is just as well that no proposal be made. However, overly restrictive criteria may conceivably eliminate a viable system. Similarly, overly loose criteria will not be of help in the sifting process. Criteria used in the Andrews University study are included as Appendix D.

The statement of criteria should include the maximum allowable total monthly cash flow for system procurement, maintenance charges, and software fees.

One of the major oversights made in the Andrews study was failure to clearly specify, as a criterion, that only systems and software installed prior to July 1973 would be considered. The date should have been set to ensure that systems could be operational and somewhat debugged before being proposed. As it was, considerable effort was

expended in studying a "paper tiger" that will probably not be available for installation until well after the specified installation deadline. Even if slippage in that system had not occurred, it is not desirable to be a pioneer. Present judgement is that optimum system age (including operating system and essential processors) is between one and four years after first installation.

A clear statement of features which would be desirable but not essential should be submitted to vendors at the first contact.

The above information is necessary to obtain a valid response from a vendor. Unless adequate guidance is given in advance proposals tend to be very sales oriented and unresponsive to institutional needs.

2.5 REQUEST FOR PROPOSAL

A written request for proposal (RFP) should be prepared prior to contacting vendors. The RFP should contain at least the following elements:

- A statement of the types of functions expected of the system.
- A statement of required vendor support functions.
- A proposal format.
- Summary forms to be filled in by vendor. Forms should be detailed enough to provide sufficient information for

hardware selection (See Section 3). Failure to provide such forms (or, as in the case of Andrews, failure to provide forms of sufficient detail) may result in being deluged with sales oriented papers. Let the vendor extract the pertinent data from his sales literature! Some caution must be taken to keep the forms unambiguous. Too much unnecessary detail may discourage a vendor from submitting a proposal.

- Policy matters. Evaluation techniques and standards (including criteria and desirable features) should be available to vendors. They may offer valid criticism of the evaluation technique if it is revealed. A statement should be included to the effect that evaluation techniques may be modified at the discretion of the study committee. Benchmark, proposal presentation, and demonstration policies and dates should be stated.
- Terms and Conditions. Non-standard terms and conditions required or desired by the institution should be stated.
- Expected time frame for contract award and debriefing should also be stated.

Although Andrews University did develop an RFP, it was not as complete as that described above. The final results of the study were probably not affected; however, workload for vendors and Andrews was clearly increased.

2.6 VENDOR CONTACT

At this point in the process all prospective vendors should be contacted. The RFP should be presented to all prospective vendors in a joint briefing session.

Section 3

HARDWARE SELECTION STUDY

3.1 INTRODUCTION

In addition to hardware capabilities this portion of the study considers system growth potential, operating system characteristics, language processors, conversion support, training support, maintenance support, and software support.

There were 22 initial system proposals. In addition, the preliminary economic study had located seven outside sources of funding. After a brief review, eight system proposals were chosen for detailed evaluation. Although Control Data Corporation elected not to submit a proposal, an excellent cross section of vendors was represented in the eight systems: Burroughs, Digital Equipment Corporation, Hewlett-Packard, Honeywell Information Systems, International Business Machines, National Cash Register, Univac Division of Sperry Rand, and Xerox.

In order to allow valid comparisons between proposed systems, each vendor was asked to supply information which would allow limited reconfiguration by the Selection Committee. Before beginning detailed comparative evaluations between the eight systems remaining, an effort

was made to reconfigure those systems to be nearly equivalent in gross capability.

Every attempt was made to keep the system cost from biasing the capability portion of the study. The best pricing formula from the eight available outside sources of funding was chosen as a common basis of cost comparisons. One vendor did have a more advantageous financing policy available which was applied to that equipment. It was expected that various vendors would reprice their proposals at later stages of the study ("What do I have to do to get the business" syndrome). For this reason undue emphasis was not placed on systems cost at this point in the study. Certain vendors use fixed price schedules, others rebid over and over. In the Andrews study one vendor resubmitted proposals three times to include enhancements, each time dropping the price. He dropped the price on two additional occasions. The initial RFP should contain a firm date beyond which rebids will not be accepted. In spite of the necessity for avoiding overall bias due to cost considerations, it is crucial to consider cost from the outset. Even with a clearly stated maximum cost criterion, several vendors submitted one or more proposals for higher cost systems.

Another major caution is avoid the "low ball" sales technique used by one vendor in the Andrews study. He proposed a system which was inadequately configured to perform required tasks in order to meet the price criterion. If the user should accept such a proposal, it is

usually only a short time until necessary additions have brought the system cost well outside the guidelines set by top management.

3.2 PROPOSAL RATING METHOD

3.2.1 Summary

Information provided by vendors was categorized and evaluated in detail by the committee. Appendix E contains detailed listings, by major categories, of the information evaluated. Items of information were arranged in columns adjacent to a weighting factor column and a column for each proposal under evaluation. After the raw data had been summarized in a similar format, the items of information were evaluated row by row. Each item was evaluated for each proposal on a scale of zero (unsatisfactory) to seven (outstanding). That score was multiplied by a weighting factor to arrive at point scores for each item analyzed. To avoid bias, the weighting factors were agreed upon prior to rating proposals. The point scores were grouped into five major categories--these were then reweighted. Their contributions to a total point score was as follows:

- Hardware Capabilities (20%).
- Growth Potential (15%).
- Operating System (20%).
- Language Processors (20%).
- Conversion, Maintenance and Software Support (25%).

Maximum possible score for the Andrews study was 700. The highest score assigned was 500.

3.2.2 Comments Regarding the Rating System

The major strength of the rating system is that it permits the many characteristics of complex systems to be broken into small units which can be realistically evaluated. The use of such a rating system allows easy preparation of questionnaires for submission to vendors as part of an RFP (let the vendors search through the boilerplate). Although it may at first appear that reliance on unverified sales presentations is a weakness of the method, a major advantage does exist: it is very unlikely that the "best choice" system will be overlooked. (What salesman will seriously underestimate the capabilities of his product line?) It was left to the benchmark programs, reference accounts, demonstrations, and acceptance test standards to ensure that a system was chosen on the basis of demonstrable characteristics rather than a well made sales presentation.

The response of each vendor to the RFP and benchmark should be evaluated as an indication of support to be expected after installation. The rationale for such a rating is the eagerness with which vendors respond should only be expected to decline after a contract is signed. Inadequate response to an RFP or benchmark request should be interpreted as a danger signal.

Overall acceptability of the study is improved when objective data is evaluated. However, it is virtually impossible to do a complete analysis without including subjective data. At least by using a weighted point method of analysis the subjective evaluations can be made in small carefully discussed units.

It is staggering to attempt an adequate evaluation of applications software, including that available from each user group, for a large group of proposals. Andrews, as part of the initial rating, found that most vendors in one way or another provided most required packages. A detailed analysis of the quality of such packages was made in a later phase of the study.

Throughput rating schemes (eg., Gibson Mix and SCERT) are useful in the initial rating period as long as they are not relied upon too heavily. The Andrews study used a throughput model only to evaluate the sensitivity of system throughput to various hardware options--no great emphasis was placed on results in the actual evaluation.

Perhaps the greatest problem is rating proposals is comparing systems which are inherently different in certain characteristics (the "apples to oranges" problem). Great care and exercise of judgement must be used in this area. Largely for this reason, a series of formal presentations was scheduled to permit one last opportunity for all selection committee members to have direct interaction with all

vendors whose proposals were being rated. Certain missing data were obtained; and, of greater importance, clarification of the precise meaning of certain data was obtained. Such meetings should be scheduled with individual vendors before attempting to finalize point rating system conclusions.

Although use of the weighted point rating method does result in a rather concrete quantitative result, lending an aura of precision to the whole study, it is worthwhile to evaluate expected limits of error present in the results.

In conducting any selection study the matter of personal bias can be a serious problem. By using a committee to review detailed data point by point the personal bias problem is reduced. Even when each committee member attempts to be carefully objective, the problem of rating a specific area high (or low) because the system in general shows a pattern of high (or low) ratings must be recognized (the "halo" effect). Apparently the best method of avoiding this problem is to ensure that all committee members are consciously and continually aware of its existence.

Considerable committee effort was spent in identifying items of data to be evaluated and setting weighting factors. It was difficult to achieve consensus in choice of weighting factors; however, agreement was reached. After evaluating all data, a sensitivity study was made which included all of the major variants in weighting factors which

had been proposed. It was discovered that the rating method was insensitive to changes in the variant weighting factor patterns proposed at Andrews.

In spite of the difficulty of gathering a set of data which accurately and adequately pertained to the specific environment, Andrews found the weighted point rating method to be highly satisfactory. Sales-pitch had been largely omitted from the rated data. After an intensive study of the top rated proposals very little disagreement was found between the initial and final ratings. Considerable effort has been expended in checking the validity and reliability of the rating system (Andrews hopes to share experience gained in the present study with approximately 80 other denominational computing centers, about 20 of which are presently engaged in or contemplating selection studies). The evaluation of the rating system in general, is that it is not the complete answer to a selection study, but does represent a highly satisfactory method for initial screening of proposals.

3.3 PUBLICATIONS

Datapro 70, Auerbach Computer Technology Reports, and various other trade journals and publications were used to verify and supplement information furnished by vendors.

Standardized reports are invaluable in sifting sales material.

Convenient summaries are presented in a standard format which permits system to system comparison between vendors. In a few cases, salesmen were not responsive to technical questions; and in those cases standardized reports were used to obtain data.

3.4 OTHER USERS

Liberal use was made of information provided by reference accounts furnished by vendors as well as information obtained from users located by other means. Although some favorable bias might be expected from reference accounts, the candor and relatively unbiased observations of users was extremely valuable in both verifying and discounting various vendor claims.

Users were especially helpful in assessing convenience and acceptance, staffing requirements, quality of applications packages, adequacy of support (all areas of support), vendor response to user's group, user's group activities and benefits, and system management features. One technical area which Andrews found almost impossible to evaluate except through user's comments was the degradation in batch throughput and terminal response time to be expected with various numbers of concurrent timesharing users. It is difficult to develop a benchmark test (which vendors will agree to perform!) which measures such degradation in a uniform manner for all vendors.

In requesting reference accounts it is important to ask each salesman

to select accounts who are using systems similar in configuration to that proposed and who have at least similar system requirements. The first questions asked of other users should also concern these matters.

Andrews made it a policy not to call any account on a reference account list without specific clearance from the appropriate sales representative. Users located via other methods were contacted freely. Although vendors were informed of comments derived from users, the exact source of derogatory information was withheld to prevent any possibility of embarrassment to the source.

3.5 CONSULTANT

In seeking out a consultant, whether the seeker is sophisticated or not, there is one hazard: "A consultant," according to a recent definition, "is somebody who says he is." Proper use of a consultant's talents require careful thought. An excellent discussion concerning the choice and use of consultants is contained in Datapro 70.

Use of a consultant does not necessarily imply great expense. In the academic community one may find others who are willing to share experience at no charge.

The advantages of using a qualified and objective person from outside

of the organization conducting the selection study are numerous and sometimes obvious (eg., experience, objectivity, lack of "political" pressure, etc.,). One advantage that should not be underestimated is the effect on top management. Even an exhaustive and objective study will benefit from the stamp of approval of a qualified outside expert ("A prophet is not without honor, save in his own country, and in his own house.").

Even if acceptance by top management is not a problem, the findings and advice of a consultant (or consultants--Andrews used two) can be valuable.

3.6 BENCHMARK TESTS

The classical benchmark test is based on a known or estimated job mix and test programs intended to simulate that mix. Frequently, the philosophy of the benchmark evaluation leads to "fastest is best." The Andrews benchmark was a demonstration as much as a benchmark (in the classical sense). Although throughput estimations were derived from the benchmark, the principle purpose of the study was to verify the versatility of system hardware and software. Special emphasis was placed on evaluating suspected weaknesses in specific systems.

A perennial problem in benchmark tests is the tendency for vendors to run the tests on a system faster or more fully configured than the

proposed system. Andrews solved this problem by requiring the benchmark tests to be rerun on the installed system as an acceptance test, and by tying payment for the system to adequate performance on the acceptance tests. (See Section 5 for terms and conditions. The introduction to the benchmark request is included as Appendix F.)

The Andrews benchmark test was not distributed until after the initial proposal ratings had been completed. Since the vendor investment in a benchmark may be very large, Andrews felt it would be unfair to ask vendors to execute the benchmark without first giving some indication of results of the preliminary rating. For that reason two letters of transmittal were used. One was given to vendors whose proposals were still of major interest, stating that a benchmark must be performed for the proposal to continue to receive consideration. (This letter was sent to four vendors; including the vendor with the machine which looked good on paper, but was clearly not demonstrable.) The second letter was given to vendors whose proposals had been eliminated on the basis of performance criteria, stating that their proposal had been tentatively eliminated, but that Andrews would reconsider that evaluation should a benchmark reveal the system proposed did meet or exceed all criteria. (This letter was sent to four vendors.)

Four of the eight benchmarks requested were completed. For the proposals tentatively eliminated, three vendors responded. (The vendor with the "paper tiger" could not respond. Another vendor with a very

highly rated machine who had been evaluated as being marginal in support capability, responded 32 days late.) For the group of proposals tentatively eliminated, one vendor responded. (The benchmark from that vendor did bear out prior conclusions of the selection committee. One other vendor in this group responded--not with a benchmark, but with a letter to the President of the University which attempted to discredit the study. Be prepared!)

It is imperative that communications be excellent in the request for benchmark. The tests must be run as specified if results of the benchmark are to permit valid comparisons between vendors. A representative of the selection committee should monitor the performance of each test. In the Andrews study direct monitoring was not feasible; however, an extended briefing session was held with each vendor to explain the purposes of all tests, execution methods, term definitions, and evaluation methods. Even with such care, some vendors did not perform certain parts of the benchmark as desired.

Each vendor was given the opportunity to use spooling and other similar features to optimize his benchmark performance. Each vendor was also invited to submit further results which might show desirable machine features.

In drafting a request for benchmark, as in drafting an RFP, it is vital to avoid making explicit or implied commitments which may limit later freedom of action.

Section 4

ACQUISITION STUDY

4.1 INTRODUCTION

Each proposal was fairly clearly ranked on the basis of previous study. This portion of the study involved very intensive analysis of the top rated systems (ideally only one or two systems should be evaluated in this phase).

4.2 APPLICATIONS SOFTWARE

A detailed evaluation of available applications packages was made for the top rated systems.

4.3 STANDARD CONTRACTS

Standard rental, purchase, and maintenance contracts as well as standard software licensing agreements should be carefully examined. Review of standard contracts by an attorney should be done as an aid in establishing terms and conditions. The final contracts must be reviewed by an attorney prior to execution.

4.4 TERMS AND CONDITIONS

Non-standard terms and conditions desired or required by the institution should be listed. Appendix G lists non-standard terms and conditions developed by the Andrews study.

Certain terms and conditions may be desirable but not strictly necessary. It is worthwhile to include such terms and conditions in the list as "trading material" during contract negotiations.

4.5 STABILITY ANALYSES

A study of the corporate economic stability of certain vendors was conducted by a member of the business and administration department faculty who teaches portfolio management. In particular, investigation was made as to the current status and importance of computer operations with respect to the total corporation. The reason for such a study was to help assess the risk of seeing the corporation bow out of the computer business during the lifetime of the machine.

Further study was made of the stability of the proposed product lines within the total vendor product lines.

4.6 FINAL CONFIGURATION REVIEW

Before beginning contract negotiations, a very careful review of the system configuration was made. Special attention was given to possible

growth patterns based on that configuration. Growth which is transparent to program systems is an important goal. It is easily possible to have more real value tied up in software and training than in hardware.

4.7 PROCUREMENT ANALYSIS

After the configuration is fixed various methods of procurement may be analyzed. Advantages and disadvantages of certain methods of procurement are outlined in Appendix H.

4.7.1 Cost Factors

In addition to the obvious rental, lease, or purchase cost and maintenance cost, careful attention must be paid to the following costs:

- Software costs.
- Conversion costs (eg., software and file conversion, parallel run costs, initial training cost, etc.).
- Installation costs (eg., site preparation, transportation, initial acquisition costs for disk packs, etc.). Site preparation estimates should be made in consultation with the vendors preinstallation team. A detailed analysis of space, power, and air-conditioning requirements should be made prior to contract negotiations.
- Staffing costs.

- Future costs (eg., field expansion charges, etc.).
- Cost removing and disposing of present system, if any.
- Cost of documentation.
- Continuing costs of training.

4.7.2 Other Factors

This phase of the study must also include careful attention to the following factors:

- Installation date commitment.
- Average time between system installation and acceptance.
- Limitations on terminals or specialized peripherals which may be attached to the system.
- Limitations on the use of the system (eg., extra shift operation, selling of outside services, etc.).
- Limitations on maintenance of systems analyst support.
- Ease of conversion.

4.8 DEMONSTRATION

Prior to entering contract negotiations a trip was made to an installation similar to that recommended by the selection committee. The trip permitted the selection committee to have a first hand look at equipment and ask final questions. Representatives of the business office, registrar's office, and administration also made the trip to obtain

evaluations of the system from their counterparts.

Had more time existed, visits would have been made to all vendors. Since all could not be visited, it was decided to reserve a demonstration visit only for the recommended vendor.

Section 5

USER-VENDOR RELATIONS AND CONTRACT NEGOTIATIONS

5.1 INTRODUCTION

Several philosophies exist for doing a selection study. Andrews chose to run a very open study. Vendors had access to the Director of the computing center at any time. Evaluation status was available to any vendor at any time. Short of revealing proprietary information, facts were not held back. This type of study involves more work than a study in which vendors are "locked out" except during specified times; however, there are several advantages. The vendors may critique the evaluation procedures during the evaluation. The vendor is permitted to respond to derogatory information. By allowing rebids and frequent vendor contacts the search for the best system at the best cost is enhanced, but at the cost of considerable effort. The Andrews study was probably too open.

5.2 COMMUNICATIONS

Good communications, throughout the study, are essential. The following points deserve special mention:

- Ground rules should be set early and in writing.

- An attitude of fairness to all vendors is crucial.
- Make no special commitments to any vendor (even the installed vendor).
- Communicate equivalent information to each vendor. This is one of the principle reasons for using a written RFP and joint briefing session.

5.3 VENDOR TACTICS

Certain vendors will attempt to sell directly to top management--especially of it appears that the selection committee study is not favoring their proposal. This may be the best argument for a closed study. Top management should be briefed to expect such contacts.

5.3 CONTRACT NEGOTIATIONS

Although one major vendor will not write non-standard contracts except for government agencies, most vendors will at least consider the individual needs of potential customers. A careful and complete consideration of this problem was made as part of the Andrews study. Every available guarantee and protection possible for the user should be included in the final contract.

BIBLIOGRAPHY

This bibliography is not indicative of all resources used in the study. Only those sources felt to be of particular value are cited.

Auerbach Publishers, Inc. Auerbach Computer Technology Reports. New York, N. Y., 1972

Reliable standardized computer system reports. Highly recommended although service is expensive.

Brandon, D. H., "Computer Acquisition Method Analysis." Datamation. September, 1972, pp. 76-79.

Excellent analysis of relative merits of rental, lease, and outright purchase. Conclusion that outright purchase is usually the best alternative is well defended.

Datapro Research Corporation, Inc. Datapro 70. Moorestown, N. J., 1972.

Factual, reliable and current standardized computer system reports. Supplementary sections cover many associated topics. A telephone research service is provided with subscription. Highly recommended as primary source for equipment evaluation information.

Kozar, K., "Computer System Selection." Working Paper Series. School of Business Administration, University of Minnesota, 1969, 35 pp.

Primarily a review of current literature. Conclusions based on review are presented.

Appendix A

NEEDS AND DESIRES

General

All Departments:
Grading; Name, Address and Bibliographic Files; Analysis of Surveys; Departmental Records and Inventories; Text Editing; Student Profiles (for Counseling); Information Retrieved (eg., ERIC)

Seminary

Concordance (COM), Textual Analysis, Syntax Analysis, Text Editing

College and Graduate School

Agriculture:
Genetics Study, Nutritional Analysis

Art:
Computer Art

Behavioral Science:
Statistical Analysis (see Math and Statistics) of Experiments and for Testing, Speech Simulation, CAI

Biology:
Genetics Simulation, Classification Studies, CAI

Business Administration:
Accounting, PERT, Linear Programming, Inventory Control, Gaming, CAI

Chemistry:
Experimental and Theoretical Analysis (Kinetics, Equilibrium, Wave Mechanics, Bonding, Etc.); Radioactive Decay Schemes and Shielding

Communication:
Textual Analysis, Text Editing, Speech Synthesis and Analysis, Bibliographic Files, Text Editing, CAI

Earth Science:
Map making, CAI

Education:
CAI Research, Textual Analysis, Statistical Analysis, CAI

Engineering:
Simulation, Circuit Analysis, Calculations, Numerical Analysis

English:
Textual and Syntax Analysis, Bibliographic Research

History and Political Science:
Bibliographic Research

Home Economics:
Nutritional Research and Analysis, CAI

Library Science:
COM, Computerized Cataloging, Bibliographic Research

Mathematics:
Numerical Analysis, Statistical Calculations, (regression Analysis, Analysis of Variance, Factor Analysis, Etc.); Support of Information Science Courses, Combinational Analysis Studies; CAI

Modern Languages:
Syntax Analysis, CAI

Music:
Electronic Music

Nursing:
CAI

Physical Education:
Statistics

Physics:
Data Reduction and Analysis, Expansion in Orthogonal Functions, Numberical Analysis, Statistical Analysis, Matrix Manipulation and Eigenvalve Problems, Signal Averaging, Simulation, Plotting, Network Analysis, Plotting and Graphics, Circuit Analysis, CAI

Religion and Biblical Languages:
Textual and Syntax Analysis, Bibliographic Research, CAI

Secretarial Science:
Familiarization with Data Processing and Computerized Files, CAI, Testing

Technology and Industrial Education:
Computer Graphics, Keypunch Training, Computer Operator Training, Computer Programmer Training

Appendix B

NEEDS VERSUS DESIRES

In order to establish specifications and criteria for computer selection, it was necessary to determine required and useful features. The determination was based on extensive meetings with faculty members (most departments were consulted) as to needed and desired applications.

Those features found to be required are listed:

- ANSI COBOL and administrative applications packages.
- Versatile timesharing (BASIC or XBASIC; ANSI FORTRAN; ANSI COBOL).
- Load-and-go FORTRAN.
- Concurrent batch and timesharing capability.
- Large batch processing capability (at least 100 K bytes) for at least COBOL and FORTRAN.
- Batch multiprogramming and spooling capability.
- Two or more 9 track tape drives.
- Capable statistical and scientific applications packages.
- Data base management system.
- Text processing system.
- Discrete and continuous simulation packages.
- String manipulation language.
- CAI language and applications packages.
- Optical page reader.
- Digital plotter.
- CPU to CPU communications capability (not necessarily implemented with initial configuration).

Those features found to be very valuable, although not absolutely required, are listed in order of priority:

- APL.
- Graphics capability.
- Digitizer.
- PERT and Linear Programming application packages.
- FORMAC.

Appendix C

COST EFFECTIVENESS STUDY FOR AUTOMATING

THE MUSIC DEPARTMENT LIBRARY

Introduction

This study will briefly address three subjects: a conservative statement of costs of present methods of acquiring and cataloging records, the cost of an automated cataloging system for records and scores, and an indication of improvements in services possible through automation.

Costs of Present Methods

The following listing describes record cataloging operations, and corresponding costs, according to present methods:

In order to prevent duplicate orders, a file of outstanding orders must be maintained. Presently, selections on only one side of the ordered record are maintained; therefore, if another teacher orders for the flip side, a duplicate order may be made. The computer would maintain a current listing of all current holdings by company and order number as well as a corresponding file for records on order with a complete listing of all selections on the record. This order file is now kept in order by a worker (not librarian)--3 hours per week, at a wage of approximately $1.80, for 40 weeks costs $256 per year. $256.00

Keeping these records cannot be done in the acquisition department because the titles on the record slip-case are not the ones we use on our cards. We use a uniform title, to keep all works score and record together for one composer. Only a trained cataloger can maintain these records.

A "New Book List" can be generated easily by the computer. To provide this service presently requires manual effort of a librarian--1-1/2 hours per month, at a wage of approximately $3.00, for 11 months costs $49.50 per year. $49.50

After a teacher makes a request, it is easy, with an automated system, to check immediately in the current catalogue to see whether or not the record is in the library. This eliminates the labor of typing an order which Mrs. Hammill must then check in the Main Card Catalog--3 hours per week, at a wage of approximately $1.80, for 50 weeks costs $270 per year. $270.00

In order to maintain the catalog, one worker presently does nothing but type cards--15 hours per week, at a wage of $1.80, costs $1,350 per year. $1,350.00

A trained librarian must then check all newly filed cards to insure Main Catalog integrity--4 hours per week, at a wage of $3.00, for 50 weeks costs $600 per year. 600.00

A dated temporary shelf-list card is made for each record. Every month this file must be manually checked to check that final copies of the catalog cards are made. Losses inevitably occur; however, with an automated system the card need not be retyped but can be automatically typed by the computer. The manual process must be done by a trained librarian--2 hours per month, at a wage of $3.00, for 12 months costs $72.00 per year. $72.00

Teachers require lists of selected records and corresponding scores for assignment of required listening. With an automated system these lists can be prepared easily by use of computer sorting techniques. The teacher can also see records and corresponding scores on the same listing (a service we are not able to provide at present) as an aid in making assignments and placing material on reserve. Even the present limited manual method is laborious and requires the services of a trained librarian--4 hours per week, at a wage of $3.00, for 48 weeks costs $576 per year. $576.00

The net cost of operating the manual record cataloging system per year is $3,124.00. Note that this does not include the cost of cataloging scores. $3,124.00

The cost to acquire and catalog a book is approximately $5.32. A record in even a single category will cost slightly more because a book has a need for only four cards--Author, Title, Subject, and Shelf list--while a record requires at least five or six cards--Composer, Title Subject (1 or 2), Performer (usually more than one), and Shelf-list card. Because of the

need for more cards, the cost for a record is at least $.20 to $.40 higher. Records having different categories on each side require a set of cards for each category--the equivalent of multiple books. Records cost considerably more than a book does to catalog. We estimate that a record which costs $3.00 to purchase will cost, very conservatively, $7.00 or more to catalog in our present system.

Costs of Automated Methods

The following summary is a conservative estimate of costs for an automated cataloging system with an annual catalog and comprehensive quarterly supplemental catalogs. The subtotals show costs for a system which catalogs only records. The final totals show costs for a complete record and score cataloging system.

As usual, there is a one-time costs for creating the system and transferring existing files to the computer:

Programming record cataloging system	$1,710.00
Keypunching and verifying existing record files:	2,437.50
Computer time for loading files:	20.00
Total implementation record cataloging system cost	$4,167.50
Programming score cataloging system:	$ 812.50
Keypunching and verifying existing score files:	420.00
Total system Implementation:	$5,400.00
Annual costs would than be quite small: Printing all required books annually:	$ 167.50
Three quarterly file updates:	15.50
Three quarterly sets of catalog supplements:	93.75
Total annual cost for record cataloging system:	$ 276.75
Printing score books quarterly:	20.00
Total annual system cost	$ 296.75

Note that if changes are required or if library

accession rate changes significantly, some changes would occur in actual costs.

It is interesting to note that the break-even point on the automated record cataloging system versus the manual system occurs almost exactly six quarters after it is first placed into operation. After that time a very substantial savings will accumulate.

Improvements in Services

Although the following comments indicate immediate expected improvements in services or other advantages of the automated system, we do not represent the listing to be exhaustive:

- The automated system offers an easy method for preventing duplicate orders. A current listing of all holdings by manufacturer and order number may be obtained at any time.
- Duplicate cards may be prepared without delay and without laborious manual typing.
- Listings of holdings in specified categories may be individually prepared for use of teacher without delay and for only a few dollars.
- Many clerical errors may be eliminated by use of keypunching followed by verification and exploitation of the inherent accuracy of the computing system itself.
- The expense and lost time in preparing duplicate cards by the Xerox process may be avoided by use of supplemental catalogs. Up to six copies of catalogs and supplements may be made at no additional charge.
- The supplemental catalog method requires no filing and allows users to easily search for required items by visual methods.
- The "on order" file can be used as a tool in order follow-up as well as a source of data for file maintenance.
- Physical inventory can be made much easier if lists of holdings in shelf-order are prepared before commencing inventory.
- Mrs. Raunio should be able to reduce a what is now significant investment of time in clerical work to nil with a significant improvement in productivity.
- The incremental cost for acquiring and cataloging new record holdings should drop from about $7.00 to about $.22. Simultaneously, the speed and range of services offered by the Music Department Library should be improved dramatically.

Appendix D

CRITERIA AND SPECIFICATIONS

In order to meet the academic and business computing needs of Andrews University as identified by the Study Committee, a satisfactory system must meet at least the following criteria:

- Total monthly cost for system and maintenance must not exceed a nominal value of $10,000.
- The system must support concurrent timesharing and batch processing.
- The system must support demonstrable ANSI COBOL, BASIC, ANSI FORTRAN, and load-and-go FORTRAN compilers.
- The system must support an adequate simulation and modeling language, and an adequate string manipulation language.
- The system must support adequate statistical and scientific subroutine packages.
- The system must support an adequate text editor and data base management system.
- The system must be available for delivery prior to June 15, 1973.
- The system must support spooling and batch multiprogramming. In a dedicated batch mode, user core area must be at least 100 K bytes (the minimum necessary to execute many standard statistical packages.
- The timesharing capability must include excellent file security features.
- The system must support nine track tapes.
- The proposed system must be capable of expansion to at least 256 K bytes main memory, 200 M bytes disk storage, and 40 communications ports.
- The vendor must be able to provide excellent maintenance support.
- The system must support existing applications.
- The internal code must be consistent with current internal code standards (ie., 8 bit internal code).
- The system must include an adequate swapping device.
- The vendor must present an acceptable conversion plan.

Appendix E

RATING SUMMARY

The following data were evaluated by the weighted point rating scheme.

Hardware Capabilities

Main memory capacity (K bytes)?
- Virtual?
- Cycle time (ns)?
- Average full word fixed point add time (us)?
- Number of instructions?
- Microprogramming?
- Registers available to programmer?
- Registers available to applications?
- Number of channels?
  - Rate (K byte/sec)?
  - Multiplex or selector?
  - Data rate on each channel (K byte/sec)?
  - Aggregate data rate (K byte/sec)?
- Interleaving?
- Throughput rating?

Disk subsystem capacity (M bytes)?
- Number of spindles?
- Transfer rate (K byte/sec)?
- Average access time (ms)?

Swapping device capacity (M bytes)?
- Number of spindles?
- Transfer rate (K bytes/sec)?
- Average access time (ms)?

Tape subsystem (number of units)?
- Number of tracks?
- Density (bpi)?
- Transfer rate (K bytes/sec)?
- Start-stop time (ms)?

Card punch (cpm)?
- Number of output stackers?

Card reader (cpm)?
- Mark sense?

Printer (lpm)?
- Chain or drum?
- Number of print positions?

Character set adequate?
Cost to change character set?
Line spacing (6,8, or variable)?
Front end processor?
Programmable?
Memory capacity?
Communications (mixed codes possible)?
Maximum transfer rate (bps)?
RJE available?
Real time available?
Maximum ports?
Reasonable terminals as configured?
CPU to CPU possible?
Handlers for RJE to HASP?
Console (type)?
Speed (cps)?

Growth Potential

Main memory sizes possible (K bytes)?
Disk memory size per spindle (M bytes)?
Spindles per controller?
Maximum number of controllers?
Maximum with proposed controller(s)?
Absolute maximum (M bytes)?
Swapping device size per spindle (M bytes)?
Spindles per controller?
Maximum number of controllers?
Maximum with proposed controller(s)?
Absolute maximum (M bytes)?
Tape speeds available (K bytes/sec)?
Speeds available on proposed controller(s)?
Can speeds be intermixed on single controller?
Densities available on proposed controller(s)?
Can densities be switch selected?
Can densities be mixed on single controller?
Can densities be changed in field?
Communications (front end available)?
Number of lines per buffer?
Number of buffers per controller?
Proposed buffers?
Proposed controllers?
Proposed ports?

Operating System

Disk files (maximum size)?
Variable size?
Indexed sequential?
Editing features?

Access independent of language?
Mixed mode creation and access?
Protection?
Tape files (maximum size)?
Variable size?
Editing features?
Access independent of language?
Mixed mode creation and access?
Protection?
Batch processing (maximum job streams)?
Maximum jobs per job stream?
User I/O blocking?
Spooling
CPU to CPU interface possible?
RJE?
Ease of JCL use?
Dynamic resource allocation?
Operator dependence?
Concurrent processing?
Job accounting?
Real time?
Swapping control?
Priority control?
Changes during execution?
First release date?
Current release date?

Language Processors

COBOL level?
Compiler size (K bytes)
Minimum practical resident (K bytes)?
Reentrant?
Generates reentrant code?
First release date?
Current release date?
Gross-reference list?
Sort?
Index sequential?
Direct access?
Interactive/conversational/batch?
RJE?
Diagnostics?
Core index?
More corresponding?
ASCII
Mixed mode?
Trace?
Checkpoint?
Bit manipulation?

```
     Specification of overflow for index sequential?
FORTRAN level?
     Compiler size (K bytes)?
     Minimum practical resident (K bytes)?
     Reentrant?
     Generates reentrant code?
     First release date?
     Current release date?
     Maximum hardware precision (bits)?
     Complex arithmetic?
     Mixed mode?
     Logical IF?
     Maximum array dimensions/indices?
     Interactive/conversational/batch?
     RJE?
     Diagnostics?
     Functional subscripts?
     Direct access for disk?
     Blocked records?
     Negative indices for DO loops?
     Read end parameters?
Load-and-go FORTRAN (available)?
     Level?
     Compiler size (K bytes)?
     Minimum practical resident (K bytes)?
     Reentrant?
     Generates reentrant code?
     First release date?
     Current release date?
     Maximum hardware precision (bits)?
     Complex arithmetic?
     Mixed mode?
     Logical IF?
     Maximum array dimensions/indices?
     Interactive/conversational/batch?
     RJE?
     Diagnostics?
     Functional subscripts?
     Direct access for disk?
     Blocked records?
     Negative indices for DO loops?
     Read end parameters?
BASIC (available)?
     Extended?
     Subroutines?
     Batch available?
          Mixed mode?
ALGOL (available)?
PL/1 (available)?
```

APL (available)?
    Extended?
    Variable workspace size?
    Mixed mode?
Discrete simulation language?
Continuous simulation language?
String manipulation language?
Formula manipulation language?
CAI language?
Data base management language?

Conversion, Maintenance and Software Support

Conversion support (overall evaluation)?
    Vendor man-hours?
        Charge?
        Location?
        Contractural protections?
    Vendor supplied CPU time?
        Charge?
            Location of nearest service center?
Maintenance support (overall evaluation)?
    Proximity of nearest repairman (miles)?
    Proximity of nearest spare parts storage (miles)?
    Proximity of back-up repairman (miles)?
    Proximity of back-up spare parts depot (miles)?
    Extra shift charges?
    P/M policy?
    Contractural protections?
Software support (overall evaluation)?
    Range of packages (overall evaluation)?
    Adequacy of packages (overall evaluation)?
    Proximity of nearest systems analyst support (miles)?
        Charges?
    Contractural protections?

Miscellaneous

Response to study (overall evaluation)?
Formal training (adequacy)?
    Charges?
    Recommended man-days?
Continued training support (adequacy)?
    Charges?
    Source?
Preinstallation support (adequacy)?
    Site survey?
        Power requirements (voltage, phase, KW and KVA)?
        Air conditioning requirements (tons--include people)?
        Raised flooring or other site modifications?
        Disk pack description?

Shipping date?
Delivery date?
Expected acceptance date?
    Contractural protections?
    Provision for parallel run on-site?
        Will vendor assume charge?
        Nearest back-up site?
Upgrade policy?
Stability of corporation?
    Stability of product line within vendor's total line?
Expectations of future product development?

Appendix F

REQUEST FOR BENCHMARK

Purpose

The principle purpose of this benchmark study is to demonstrate that certain representative programs can be executed, on the systems proposed for installation at Andrews University, by vendors receiving this request. Sample production programs, and appropriate test data, are also included in order to measure ease of conversion. The secondary purpose of the study is to measure compile, execution, and response times of representative programs, under controlled circumstances, as an aid in assessing processing capabilities of the various proposed systems.

Andrews University does not suggest that the programs submitted constitute a comprehensive or representative mix of processing to be accomplished in the future. Rather, the programs were chosen to exercise certain compiler and machine features which are of particular interest.

Time Frame

In order to obtain system delivery at a time acceptable to Andrews University, an order must be placed no later than the middle of January 1973. For that reason we must require that results of this study be in the hands of LeRoy Botten absolutely no later than 1:00 p.m. on January 8, 1973. Please do not request deviations from this policy, none can be granted. If for some reason the study can not be completed, please return partial results. Results received after the stated time can not be considered.

Evaluation of Results

Andrews University reserves the right to make the final determination of the value and usefulness of any or all parts of the study. In view of the commonly understood difficulties of conducting a fair benchmark study, we do not intend to make a final determination necessarily based on the results of the benchmark. Nevertheless, we do desire results which can be used to make meaningful comparisons between proposed systems.

Since a relatively short time has been allowed to complete the study, we do not expect that a test system will be configured precisely to the bid configuration. It is necessary that a full description of the test

configuration be forwarded with test results. Results submitted without an adequate configuration summary will not be considered.

One of the most difficult tasks in evaluating a benchmark study is determining how variations between bid and test configurations have biased results. Realizing that each vendor is in the best position to understand any existing biases, we expect that a full disclosure of such biases will accompany test results. The cover letter accompanying test results, or partial test results, must contain the following statement:

> "(Vendor) certifies the configuration proposed for Andrews University will meet or exceed performance standards specified or implied by the attached benchmark test results. Where necessary, due to differences between proposed and test configuration, results of tests have been adjusted to represent the proposed configuration performance. All such adjustments have been specifically noted. (Vendor) is willing to include in the final contract a commitment to rerun the benchmark study on the installed system as a final acceptance test such that system acceptance by Andrews University will be contingent on performance equal or better in all respects that performance specified or implied by the enclosed test results."

Please understand the intent of the above paragraph is to help prevent a difficulty common to many benchmarks: test systems that are configured to perform better than proposed systems. Vendor cooperation with the intent of this paragraph should help Andrews University to fairly interpret the results of this benchmark study. Results submitted without the above statement will not be considered.

Programs

The test programs (described in enclosures) will be identified in the test procedures as follows:

BASIC

B1	BATCH REGRESSION
B2	CONVERSATIONAL REGRESSION
B3	RANDOM
B4	MATRIX
B5	FILES
B6	GRAPH
B7	ALPHA
B8	B CRUNCH

COBOL

C1	FILE	
C2	CREATE UPDATE	
C3	PRINT	
C4	COPY	
C5	SORT	
C6	DEMO	(data for C2, CREATE)
C7	DEMO	(data for C2, UPDATE)

FORTRAN

F1	F CRUNCH
F2	DIFFRACTION
F3	FOURIER
F4	EQNS
F5	COMPLEX

Conversion Test

Record man-hours and systems resources required to convert COBOL programs C1, C2, C3, C4, and C5. Provide listings of converted programs.

Dedicated Machine Performance Tests

In order to allow controlled timing tests, the following programs are to be separately run on a totally dedicated system in the timesharing mode: B8, C1, F1. Program logic includes print statements which are to be used in timing. Using a stopwatch, time the interval between the "RUN" command and start of the output, "START;" record this interval as "compile time." Using a stopwatch, time the interval between the start of output, "START," and the completion of output, "STOP;" record this interval as "execution time."

Similarly, the following programs are to be separately run on a totally dedicated system in the batch mode: B8, C1, F1. Modify program code as necessary to use system interval timer to record "compile time" and "execution time" as defined in the previous paragraph. Record interval timer precision.

Language Tests

Make coding changes required to execute B1, B2, B3, B4, B5, B6, and B7 in the timesharing mode. Submit a listing of each program as executed and corresponding output.

Make coding changes required to execute C2, C3, C4, and C5. Submit a listing of each program as executed, compile-through-load time for each program, and output from C3. Timing to be based on system interval timer (make coding changes required for its use with each program).

Make coding changes required to execute F2, F3, F4, and F5. Submit a listing of each program as executed, compile-through-load time for each program, and output from each program. Timing to be based on system interval timer (make coding changes required for its use with each program).

Multiprogramming and Concurrent Processing Tests

For the background processing in this test two job streams are to be used: a precompiled COBOL job stream composed of data C6 and C7 processed by precompiled programs C2, C3, and C4; and a sequence of compile-and-go runs for F2, F3, F4, and F5. Each of these job streams is to be run in the order shown. On completion of each sequence the cycle is to be immediately restarted (eg., F2, F3, F4, F5, F2, F3, F4, F5, F2,...). Using the system interval timer, measure the time from start to end of each sequence (as requested below) and record as "COBOL sequence time (CST)" and "FORTRAN sequence time (FST)" respectively. Submit a listing of each sequence as executed.

No Timesharing Users

Record average values of CST and FST with no timesharing users.

Five Timesharing Users

Record average values of CST and FST with five timesharing users occupied as follows (each user repeats his "assigned" process during duration of test phase):

1	creating and debugging B1
2	running B2
1	creating and debugging C1
1	creating and debugging F5

Ten Timesharing Users

Same as for five timesharing users, except two sets of timesharing users as described above.

Fifteen Timesharing Users

Same as for five timesharing users, except three sets of five timesharing users as described above.

Minimum Standards

Although all parts of the benchmark test are of interest, the time allowed for completion is somewhat less than would normally be expected. Andrews University is most interested in complete results for the Conversion Test, the Language Tests, and at least some demonstration of multiprogramming and concurrent (timesharing with batch) operation. When these results are assured the other tests should be run.

Appendix G

NON-STANDARD CONTRACTURAL ARRANGEMENTS

Every attempt should be made in contract negotiations to obtain the following non-standard protections:

- Stationing of a customer engineer and storage of essential spares at Andrews University (even if we must provide office and storage space).
- Specification of new style memory.
- Guarantee of upgrade and trade-in privilege for components under installment purchase plan for at least the first eighteen months after installation.
- Guarantee of provision for maintenance of all system components for the entire life of the installment purchase contract with escalation protection.
- Non-appropriation clause.
- Provision for system and software acceptance tests.
- Conversion and installation non-performance penalties.
- Guarantee of adequate system analyst support for entire life of the installment purchase contract.
- Guarantee of adequate documentation at fixed cost.
- Guarantee of adequate training assistance at fixed cost.
- Right to pay off balance without penalty.
- Right to transfer equipment to any affiliate of General Conference of Seventh-day Adventists without jeopardizing maintenance or systems analyst support.
- Right to use independent memory or peripheral equipment.
- Bundling guarantee for entire life of the installment purchase contract.

Appendix H

METHODS OF FINANCING

H.1 OUTRIGHT PURCHASE

Although this method appears to be the least expensive, the cost of capital may be ignored only if the institution should have a large available cash surplus. Purchasing with borrowed money and repaying with inflated dollars may have substantial benefits; however, one must consider the reduction in available credit. In any case, it does not appear feasible for most universities to make the capital investment necessary to obtain a satisfactory computing system.

H.2 THIRD PARTY LEASEBACK

This method of financing consists of purchasing the equipment (in order to take advantage of all educational discounts), reselling the equipment to a third party (who supplies the capital), and leasing the equipment from the third party. The third party anticipates profits from two sources: from tax relief not available to a non-profit educational institution; and from interest payments, and possibly, retention of residual value.

H.2.1 Advantages of Leaseback Over Outright Purchase

The major purpose of leasing is to obtain the use of capital equipment without having to make capital expenditures. Lease payments can provide a cash flow superior to that of purchase over the early years of the equipment's life. Leasing is an effective hedge against inflation; however, to be fair, depreciation deductions can suffer a negative effect from inflation.

H.2.2 Advantages of Leaseback Over Traditional Financing

Leasing may actually give a cheaper rate. This is particularly true when lessee cannot take advantage of tax benefits such as depreciation and investment tax credit--the lessor can purchase the equipment, claim the tax benefits, and pass the savings on. Leasing spares the use of existing lines of credit and allows full use of borrowing capacity. Most leases provide 100% financing--not even a deposit or down payment dips into capital. Often even acquisition costs (delivery cost, etc.) can be spread over the lease payments.

H.3 RENTAL

The vendor rental agreement offers many of the advantages of third-party lease methods; although invariably, at higher costs. The major advantages of vendor rental agreements are the capability to easily arrange for upgrade without having to dispose of existing equipment, and the capability to easily arrange for replacement of particular pieces of equipment which may be only marginally serviceable. The last advantage may be particularly important in case of mechanical equipment subject to rapid wear (eg., card punches, printer, or card readers).

H.4 VENDOR INSTALLMENT PURCHASE

Most vendors offer an installment purchase plan. Provisions vary considerably from vendor to vendor.